Title: Exploring the Binomial Probability Distribution

Link to Outcomes:

- **Communication** Students will be able to express results of data collection by using charts/tables and histograms.
- **Probability** Students will demonstrate an understanding of the binomial probability distribution.
- **Technology** Students will use data generated by the TI-82 graphics calculator.

Brief Overview:

Students will simulate the binomial probability distribution using two methods: an exercise in coin-flipping and a TI-82 calculator program.

Grade/Level:

Grades 9-12

Duration/Length:

This lesson is expected to take 3-4 class periods, depending on the amount of time spent discussing related theory and developing necessary calculator skills.

Prerequisite Knowledge:

Students should:

- understand the Fundamental Counting Principle.
- be familiar with counting outcomes via a tree diagram.
- be able to compute ${}_nC_r$.

Objectives:

Students will:

- form a tally sheet of the results of coin flips.
- form a histogram of the coin flip results, both individual and class.
- compute related probabilities via the binomial distribution formula.
- generate data with a computer simulation.
- use the TI-82 to show a histogram of a set of data.

Materials/Resources/Printed Materials:

- TI-82 graphics calculators
- Graph paper
- Rulers
- Worksheets for tallies and histograms
- Coins

Development/Procedures:

- Explain the four conditions of the binomial probability experiment.
  a. There must be a finite number of trials.
  b. There are only 2 possible outcomes (success or failure) per trial.
  c. The probability of success remains the same from trial to trial.
  d. The trials are independent.
- Discuss the possible outcomes (i.e., number of heads) on a single flip of 4 coins, using a tree diagram and list the probability of each outcome(0, 1 ,2 , 3, or 4 heads)
- Have students perform the coin-flipping experiment as described on Worksheet 1.
- Use the data to draw a histogram of each individual student's data.
- Tabulate class data and draw a second histogram.
- Use the TI-82 to compare the two histograms with theoretical frequencies from the tree diagram.
- Guide students in using the probability distribution formula $P(r) = {}_nC_r\,(p)^r\,(1\text{-}p)^{n\text{-}r}$.
- Simulate the coin-tossing experiment using a TI-82 program.
- Have students draw a histogram of the TI-82 program simulation.

Evaluation:

The teacher will circulate as the students perform the simulations and construct the histograms. The histograms and the results will be used to determine grades.

Extension/Follow Up:

Encourage students with programming skills to write a computer simulation of the coin-flipping experiment using dice, with the two outcomes being "odd" and "even."

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Name_____
Date_____
Period_____

Worksheet 1 - Coin-Flipping Experiment

Flip a coin in 32 sets of 4 flips. Record the results in the boxes shown below (e.g., HHTH). Tabulate the number of sets where you get 0, 1, 2, 3, or 4 heads, respectively, on the tally sheet.

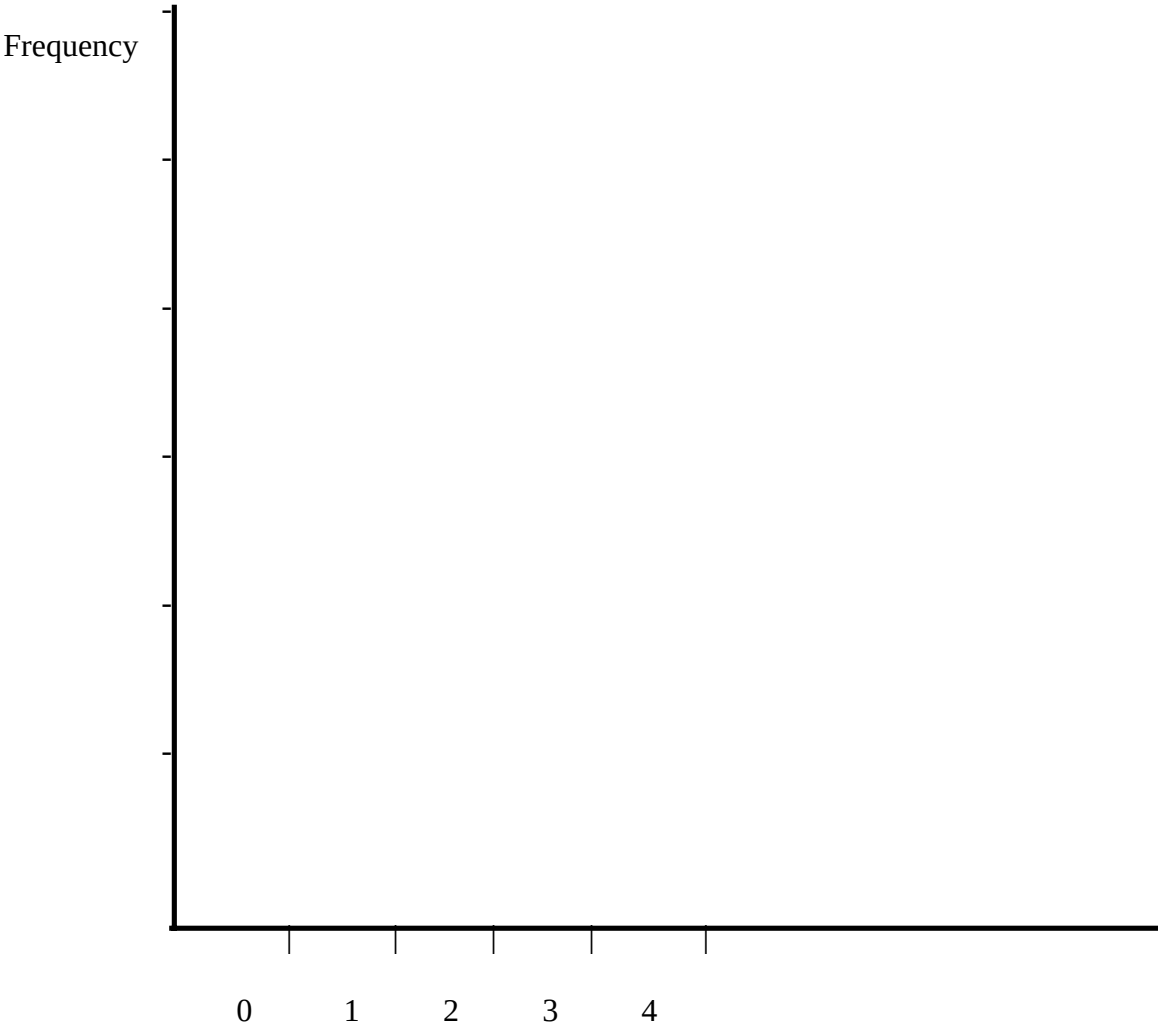
Record of flips

TALLY SHEET

Number of heads	0	1	2	3	4

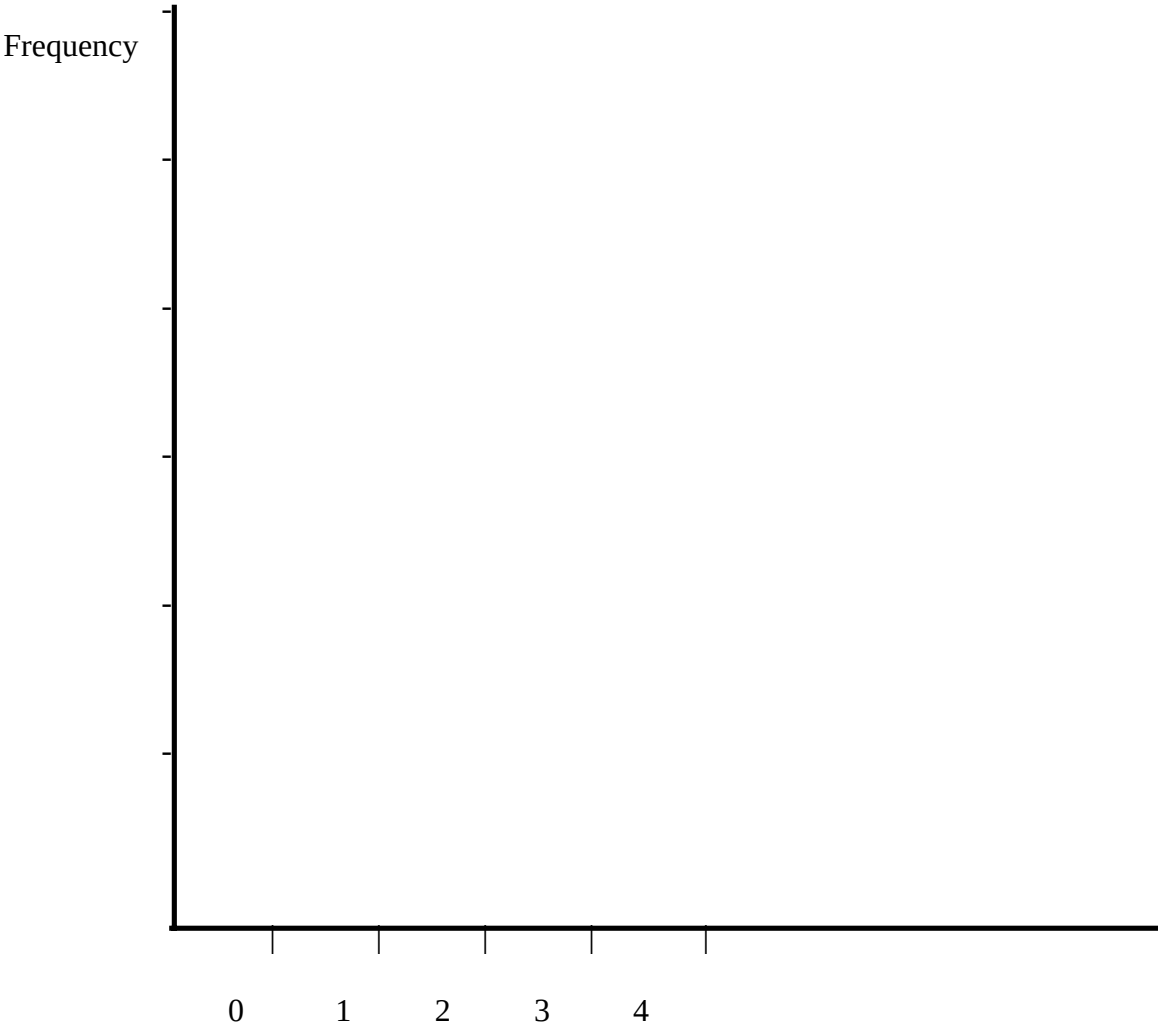
Name_____
Date_____
Period_____

Histogram of Individual Data



Name_____
Date_____
Period_____

Histogram of Class Data



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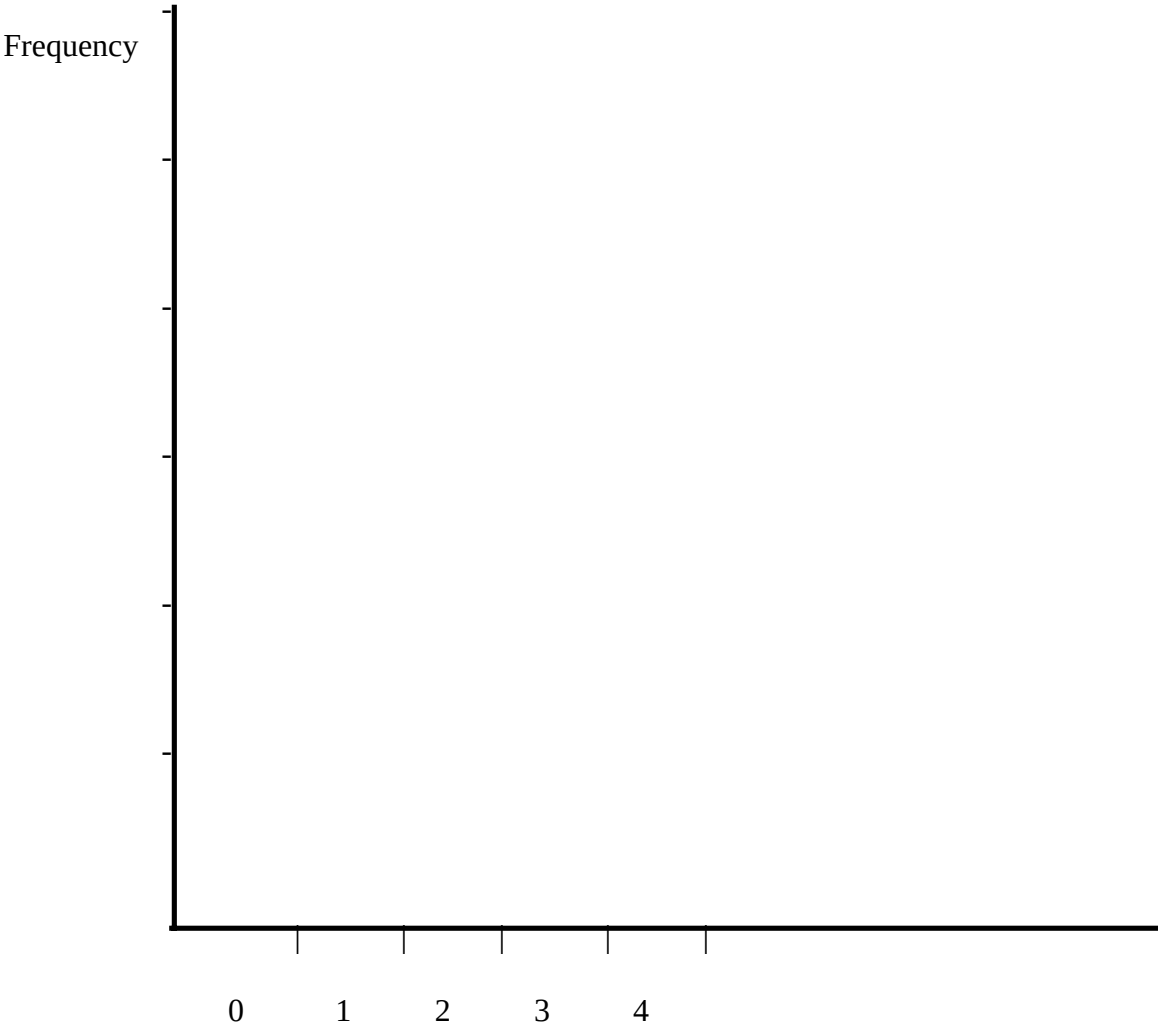
Histogram of TI-82 Simulation



Number of Heads	P(H) determined by relative frequency	P(H) determined by formula
0		
1		
2		
3		
4		

Binomial Probability Distribution Formula

$$P(r) = {}_nC_r\,(p)^r\,(1-p)^{n-r}$$

P(r) = Probability of r heads in a set of n flips

n= Number of flips per set

r = Number of heads

p = Probability of getting a success on any one trial (flip)

${}_nC_r$ = combination of n objects(coin flips per set) taken r (heads) at a time

TI-82 Computer Program - “Flip Coin”

: Clr Home

: 1 -> X

: Lbl K

: Clr Home

: Disp “FLIP NUMBER”

: Disp X

: Disp “ ”

: If rand <.5

: Then

: Disp “HEAD”

: Else

: Disp “TAIL”

: End

: X + 1 -> X

: Disp “ ”

: Disp “PRESS 2ND ON TO “

: Disp “QUIT”

: Pause

: Go to K